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(54) Hooke's joints

(57) A Hookes type universal joint has at least one shaped surface part 12 provided on the bearing bush 13 or on the cylindrical bore in a yoke to provide a gap between the bush and the circumferential surface of the bore in the yoke to allow for resilient deformation of the cooperating parts during use of the joint to more evenly spread the load throughout the cooperating surfaces.

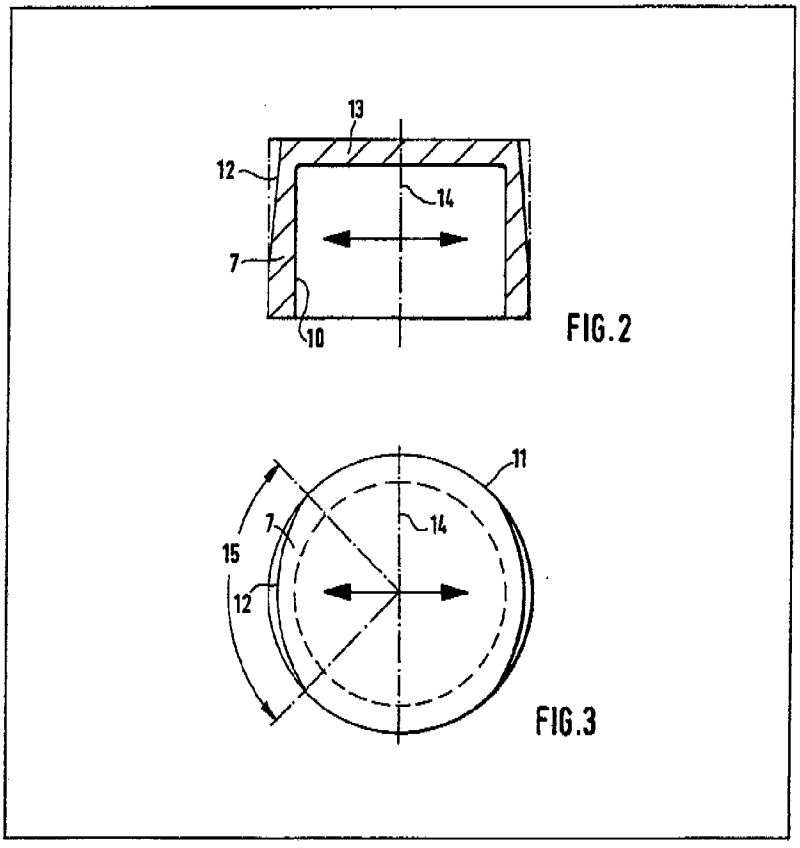

FIG.2

FIG.3

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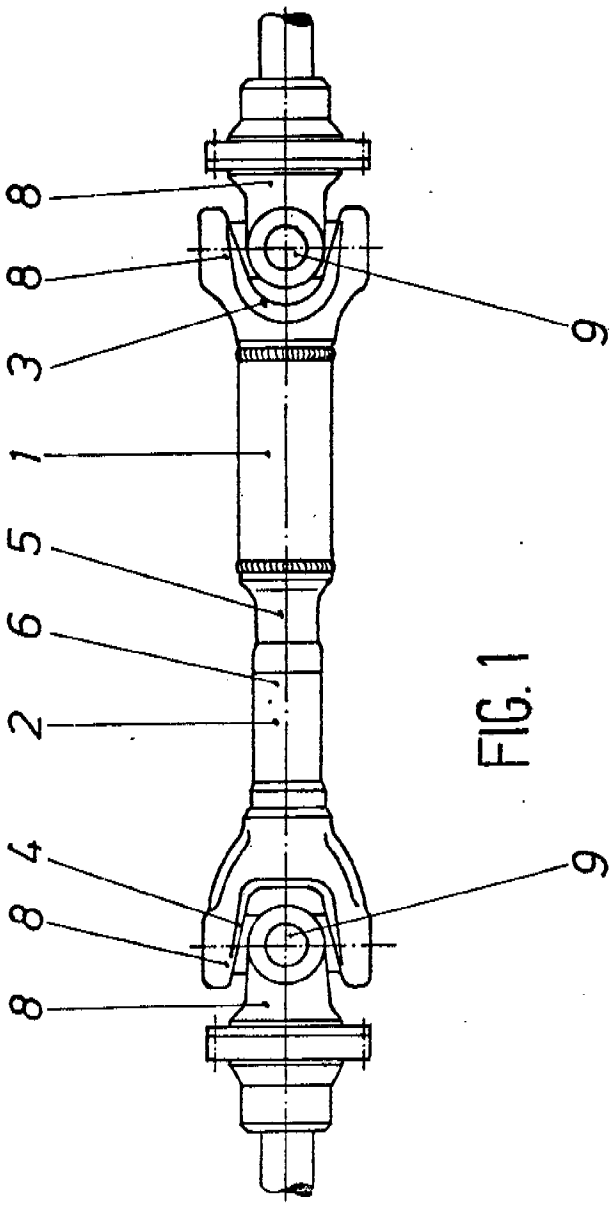

FIG. 1

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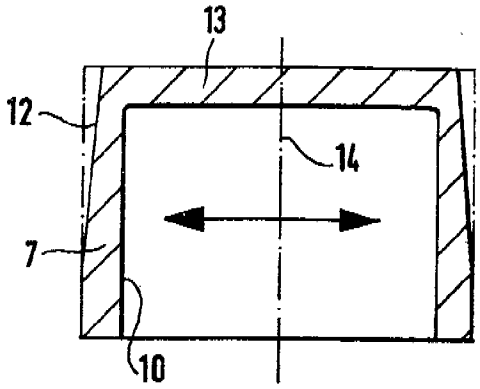

FIG.2

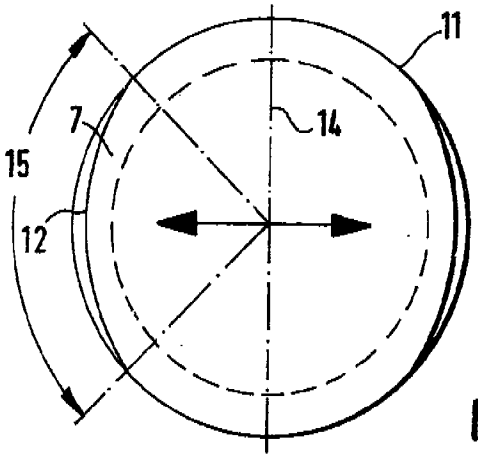

FIG.3

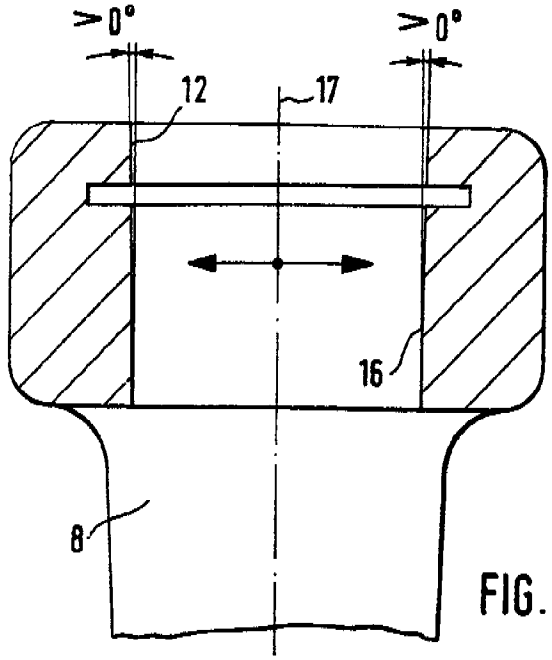

FIG.4

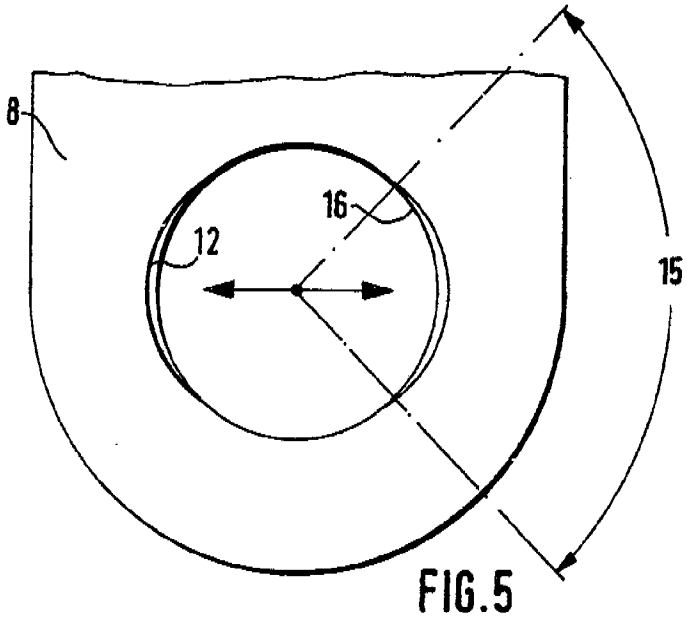

FIG.5

SPECIFICATION

Improvements in or relating to universal joints

Description of Invention

The present invention relates to an improved universal joint of the type known as a Hookes joint. Such a joint, hereinafter referred to as a joint of the type specified, comprises a pair of yokes, each yoke having diametrically opposed bores in which are received trunnions of a cruciform member, the cruciform member interconnecting the two yokes.

West German Patent Specification No. 1,122,781 describes a universal joint in which, when no load is applied to the joint, the bearing faces of the trunnions of the cruciform member are not parallel to the bearing faces of bushes present between the trunnions and the bores in the yokes. This results in a gap between the trunnion and the bush which increases in size in a direction outwardly from the centre of the cruciform member. Such a gap can be formed by providing a trunnion of frusto-conical configuration or by providing a frusto-conical inside bearing surface on the bearing bush. In practice, the grinding of a frusto-conical trunnion on a cruciform member presents difficulties and the provision of a frusto-conical surface on the inside of the bearing bush presents problems, particularly as the circumference of the bearing surface increases in a direction away from the open end of the bush.

West German published Patent Application OS No. 2,737,557 discloses a universal joint in which the load acting on the bearing surrounding a trunnion is borne by a number of needle bearings so that the characteristics of the joint are improved and its surface life is extended. In order to provide these advantages the trunnion is ground so that it is of elliptical form in order that a plurality of the needle bearings absorb the forces acting between the trunnions and the bearing bush. Once again, the production of cruciform members having trunnions of elliptical form presents problems.

It is an object of the present invention to provide an improved universal joint of the type specified.

According to the present invention we provide a universal joint of the type specified wherein said bores having respective bushes therein which receive the corresponding trunnions and wherein, in the absence of torque transmission through the joint at least part of the peripheral surface of each bush and the cooperating surface of the respective bore are spaced from each other by a gap which increases in a direction away from the centre of the cruciform member.

Such an arrangement has the advantage that, due to the deformation of the yokes and bushes during use of the joint under torque load, resilient deformation of the bush is optimised.

The gap may be provided by shaping the bush so that its peripheral surface which cooperates with the bore in the yoke, is tapered inwardly in a direction towards the longitudinal axis of the respective trunnion in a direction extending away from the centre of the cruciform member. Preferably there are two or so shaped peripheral surface parts diametrically opposite each other so that the diameter of the bush across said surface parts decreases in a direction away from the centre of the cruciform member.

Such a configuration enables the bearing bush to resiliently deform under load which results in the torque being transmitted through the joint being more evenly spread over the cooperating surfaces, thereby enabling a greater torque to be transmitted through a joint of given capacity, or, where maximum torque is being transmitted, an increase in the service life of the joint.

It will be appreciated that bearing members may be provided between the trunnions of the cruciform member and their respective bushes.

As an alternative to providing a bush of a shape which provides the gap in the joint of the present invention, the gap may be provided by shaping the bores in the yokes. In this case, at least part of the circumferential surface of each of the bores may be shaped by any convenient method so that the diameter of the bore in a region of said circumferential surface part increases in a direction away from the centre of the cruciform member when engaged in the yoke.

Once again, two circumferential surface parts could be provided to provide diametrically opposed gaps between the bores in a yoke and the respective bushes in order to accommodate resilient formation of the respective parts in both directions of rotation.

In order to provide said surface parts, when for example providing a surface part on the bush so as to provide said gap, such a surface part may be provided by any suitable manner including a non-cutting deformation of the bush so that the surface part has a radius of curvature which is greater than the radius of the outer surface of the bush.

As an alternative, the surface parts formed to provide said gap may have a radius which is smaller than the radius of the bore in the yoke. In this case it is advantageous that when the circumferential surface part is provided by forming the bores of a special configuration, said surface parts may be simply produced by means of a non-cutting shaping operation.

Preferably said surface parts may be of frusto-conical form and, where two such surface parts are provided diametrically opposed to each other, the generating radius of said surface parts is coincident with the longitudinal axis of the respective trunnion.

To ensure that the resilient deformation of the parts of the joint is effective over the entire range of bending angle of the joint, the surface parts each subtend an angle at the central axis of the trunnion when the joint is assembled of a size greater than twice the maximum bending angle of the joint.

The invention will now be described in more

detail, with reference to the accompanying drawings wherein:—

FIGURE 1 shows a universal joint shaft having a pair of Hookes joints, one at each end thereof;

FIGURE 2 is a sectional view of a bearing bush in a joint of the present invention;

FIGURE 3 is a plan view of the bearing bush shown in Figure 2;

FIGURE 4 is a sectional view illustrating one of the bores in a yoke;

FIGURE 5 is a plan view of the yoke shown in section in Figure 4.

A drive shaft including two Hookes type universal joints is shown in Figure 1. The drive shaft comprises drive shaft sections 1 and 2 which each carry a yoke arm 8 at their outer ends, which yoke arms 8 form parts of universal joints 3 and 4 respectively, the universal joints 3 and 4 each including a cruciform member 9. The shaft section 1 is constructed as a solid shaft 5 at its inner end and is provided with a splined outer surface which cooperates with the splined inner surface of a hollow shaft section 6 provided on the drive shaft 2. The drive shaft sections 1 and 2 can thus slide in an axial direction relative to each other but are non-rotatably connected to each other via the cooperating splined sections, thereby enabling the transmission of torque from one to the other.

Referring now to Figures 2 and 3, a bearing bush 7 is illustrated in detail. The bearing bush 7, when the joint is assembled, is arranged on a trunnion usually through the intermediary of bearing needles which bear on the outer surface of the trunnion and the inner surface 10 of the bearing bush 7.

The bush 7 is provided with two frusto-conical surface parts 12 on its outer surface 11, the frusto-conical surface parts being diametrically opposite each other and formed so that the diameter of said bush across the surface parts 12 decreases in a direction extending outwardly from the centre of the cruciform member.

The frusto-conical surface parts 12 each extend around the circumference of the bush 7 so that they subtend an angle at the centre of the bush which is greater than twice the bending angle of the joint.

Referring now to Figures 4 and 5, one of the bores in a yoke arm is illustrated, which bore receives a bush, the bore being provided with diametrically opposed frusto-conical surface parts 12 so formed that the diameter of said bore in the region of said surface parts 12 increases in the direction extending radially away from the centre of the cruciform member.

Once again, the circumferential surface parts 12 subtend an angle at the centre which is greater than twice the bending angle of the joint.

By providing the surface parts on the periphery of the bush, or on the bore of the yoke arm, or both, to provide a gap the bush 7 is resiliently deformed under load thereby increasing the load on any bearings present between the trunnion and the bush in a direction radially outwardly from the centre of the joint and thus the load on the individual bearing needles, when present, is greater at their radially innermost end. This results in a fairly uniform load on the bearing needles and optimum utilisation of the bearing capacity on the joint as a whole.

CLAIMS

1. A universal joint of the type specified wherein said bores having respective bushes therein which receive the corresponding trunnions and wherein, in the absence of torque transmission through the joint, at least part of the peripheral surface of each bush and the cooperating surface of the respective bore are spaced from each other by a gap which increases in a direction away from the centre of the cruciform member.

2. A universal joint of the type specified as claimed in claim 1 wherein said gap is provided by shaping the peripheral surface of said bush.

3. A universal joint of the type specified as claimed in claim 1 wherein said gap is provided by shaping the bores of the yokes.

4. A universal joint of the type specified as claimed in any one of the preceding claim wherein at least two of said surface parts are provided diametrically opposite each other.

5. A universal joint of the type specified as claimed in claim 2 wherein said gap is provided by forming a frusto-conical surface part on the periphery of said bush.

6. A universal joint of the type specified as claimed in claim 3 wherein said gap is provided by forming a frusto-conical surface part on the circumferential surface of the bore of said yoke.

7. A universal joint of the type specified as claimed in claim 5 or claim 6 wherein the generating radius of said frusto-conical surface part is coincident with the central axis of said trunnion on assembly of the joint.

8. A universal joint of the type specified as claimed in any one of the preceding claims wherein the or each said surface part subtend an angle at the central axis of the trunnion when the joint is assembled of a size greater than twice the maximum bending angle of the joint.

9. A universal joint of the type specified substantially as hereinbefore described including bushes substantially as hereinbefore described and illustrated with reference to Figures 2 and 3 of the accompanying drawings.

10. A universal joint of the type specified substantially as hereinbefore described including yokes having bores formed therein substantially as hereinbeofre described with reference to and as

illustrated in Figures 4 and 5 of the accompanying drawings.

11. A universal joint of the type specified including any novel feature or combination of features as described and/or illustrated in the accompanying drawings.

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